Name: Key Due Date: _____

HONORS CHEM: SOLUTIONS REVIEW PACKET

1. A solution is best described as a
   a. heterogeneous mixture ← colloid suspension
   b. homogeneous mixture
   c. compound
   d. element

2. A change in pressure will have the greatest influence on the solubility of a (only affects gases)
   a. solid in a liquid
   b. liquid in a gas
   c. gas in a liquid
   d. liquid in a solid

   Pressure will confine the gas to get it to dissolve.

3. As temperature increases, the solubility of solid calcium chloride in water
   a. increases
   b. decreases
   c. remains the same

   ↑ temp ↑ solubility of a solid

4. Based on the *Solubility Guidelines* chemistry reference table, which compound is insoluble? (Table F)
   a. barium sulfate
   b. sodium sulfate
   c. potassium sulfate
   d. lithium sulfate

   exception to SO_4^{2-} rule

5. Compounds containing the chloride ion (Cl^-) are insoluble when combined with (Table F)
   a. magnesium (Mg^{2+})
   b. silver (Ag^+)
   c. sodium (Na^+)
   d. calcium (Ca^{2+})

6. According to the *Solubility Curves* (Table G) chemistry reference table, what is the maximum number of grams of NH_4Cl that will dissolve in 200g of water at 70°C?
   a. 62 g
   b. 124 g
   c. 100 g
   d. 85 g

   62g NH_4Cl / 100g H_2O

7. According to the Solubility Curves (Table G) chemistry reference table, the solubility of which compound decreases most rapidly as the temperature changes from 10°C to 70°C?
   a. KCl 30g → 48g
   b. NH_4Cl 34g → 62g (increased = solid)
   c. HCl 77g → 52g
   d. NH_3 70g → 18g

   CHECK EACH ONE!! These are gases

8. Which solution contains the greatest number of moles of solute?
   a. 2 L of a 2 M solution — 4 mol
   b. 0.5 L of a 2 M solution — 1 mol
   c. 0.5 L of a 0.5 M solution — .25 mol
   d. 2 L of a 0.5 M solution — 1 mol

   $M = \frac{mol}{L}$

   * $M \times L = \#\ moles$

9. How many grams of KOH are needed to prepare 250 ML of a 2.00 M solution of KOH? (gram formula mass = 56.0 g/mol)
   a. 112 g
   b. 2.00 g
   c. 1.00 g
   d. 28.0 g

   ↳ convert to L

   $M = \frac{mol}{L}$ $\quad 2.00M = \frac{x\ mol}{.250L}$ $\quad x = .5\ mol$

   $.5\ mol\ KOH \left(\frac{56.0\ g}{1\ mol}\right) = 28g$

ppm = $\frac{\text{mass solute}}{\text{mass solution}} \times 10^6$

10. How many grams of KI are needed to prepare 2,000 g of an aqueous solution containing 25 parts per million (ppm) of solute?
    a. 5.0×10^4 g
    b. 0.0125 g
    c. 0.050 g
    d. 1.25×10^4 g

$\frac{25 \text{ ppm}}{10^6} = \frac{x}{2000 \text{ g solution}}$ $x = .05$

11. A solution is made by dissolving an electrolyte in water. The solution conducts electricity as a result of the presence of
    a. atoms
    b. ions
    c. molecules
    d. compounds

freely moving charged particle

12. Which solution has the highest boiling point?
    a. 1 mole of $NaNO_3$ in 750 g of water
    b. 1 mole of $NaNO_3$ in 1000 g of water
    c. 1 mole of $NaNO_3$ in 250 g of water
    d. 1 mole of $NaNO_3$ in 500 g of water

most amount of dissolved solute.

* ↑ solute or ↓ solvent

same solute

Lowest solvent

13. What factors determine the degree of solubility of a substance in a solution?

how much solute dissolves.

Solids~ ↑ temp ↑ solubility

Gases~ ↑ temp ↓ solubility
↑ pressure ↑ solubility

} nature of solute + solvent influences both solids + gases

14. Identify three ways to increase the rate of solution for:

How fast it dissolves

Solid solutes~ crush solute
inc. temp of solvent
stir

Gaseous solutes~ ↑ pressure
↓ temp of solvent
do not agitate

15. Explain the saying "like dissolves like" and its relevance to solution formation.

Substances with similar polarities will easily create a solution.

Table F

16. Identify if each of the following ionic substances is soluble or insoluble in water.

a. Na_2CO_3 soluble

b. $CaSO_4$ insoluble

c. ammonium nitrate soluble

d. copper (II) bromide soluble

↳ $CuBr_2$

17. Determine the products for each of the following double replacement reactions. Identify the insoluble product (if any).

a. $K_2SO_4\,(aq) + 2AgNO_3\,(aq) \rightarrow 2KNO_3\,(aq) + Ag_2SO_4\,(s)$

($K^+ SO_4^{2-}$ $Ag^+ NO_3^-$)

b. $K_2S\,(aq) + Cu(ClO_3)_2\,(aq) \rightarrow CuS\,(s) + 2KClO_3\,(aq)$

($K^+ S^{2-}$ $Cu^{+2} ClO_3^-$)

18. Identify the substance that creates a saturated solution on The line Table G under the listed conditions.

a. 5 g solute in 100 g solvent at 50°C SO_2

b. 140 g solute in 200 g solvent at 23°C HCl

70g / 100g @ 23°

c. 55 g solute in 50 g solvent at 45°C $NaNO_3$

↙ 110g / 100g H_2O @ 45°C

19. Identify if each of the following represents an unsaturated, saturated or supersaturated solution. * determine amount to be saturated → on Line Table G → to Be saturated 45g / 100g H_2O

above line

a. 45 g KCl in 100g H_2O at 60°C saturated

b. 70 g KI in 50 g H_2O at 10°C supersaturated

140 g KI / 100 g H_2O @ 10°C

c. 80 g NaCl in 200 g H_2O at 90°C saturated

40g NaCl / 100g H_2O @ 90°

under line

136g / 100g H_2O

40g / 100g H_2O

20. If 100 g of KI is dissolved in 100 g water at 20°C, how much more KI must be added to saturate the solution at that temperature?

@20°C 145g KI will saturate 100g H_2O

145g − 100g = 45g needed

21. A saturated solution of KNO_3 is cooled from 60°C to 50°C, how much KNO_3 precipitated from the solution?

saturated @ 60°C 107g

saturated @ 50°C 84g

23g will settle out.

22. Determine the molarity of a solution that contains 47.8 g Na_2CO_3 dissolved in water to make a 7.5 L solution.

g → mol

$M = \frac{\text{mol solute}}{\text{L solution}}$

Na 2(22.99) = 45.98
C 1(12.01) = 12.01
O 3(16.00) = 48.00
105.99 g/mol

$47.8\text{g } Na_2CO_3\left(\frac{1\text{ mol}}{105.99\text{g}}\right) = .450986\text{ mol}$

$M = \frac{.450986\text{ mol}}{7.5\text{ L}} = .06013$

.060M Na_2CO_3

23. What volume is needed to make a 2.0 M solution of Li_2SO_3 if 1.25 moles of solute is used?

M = mol/L

$M = \frac{\text{mol solute}}{\text{L solution}}$

$2.0\text{ M} = \frac{1.25\text{ mol}}{X\text{ L}}$ OR $1.25\text{ mol}\left(\frac{1\text{ L}}{2.0\text{ mol}}\right)$

$X = .625\text{ L} = .63\text{ L}$

24. What is the percent mass of a solution that contains 28 g KBr in 250 g of water?

$\% = \frac{\text{mass solute}}{\text{mass solution}} \times 100$

* need to find total solution

solute + solvent = solution
28g + 250g = 278g solution

$\frac{28\text{g KBr}}{278\text{g solution}} \times 100 = 10.1\%\text{ KBr}$

25. A 13 g sample of water contains 4.5×10^{-4} g of fluoride ions. What is the concentration of fluoride ions in parts per million?

$ppm = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$

$\frac{4.5 \times 10^{-4}\text{ g fluoride}}{13\text{ g solution}} \times 10^6 = 34.61538$

35 ppm fluoride

26. What mass of NaOH is dissolved in 560 g of a 22% NaOH solution?

$\% = \frac{\text{mass solute}}{\text{mass solution}} \times 100$

$\frac{22}{100} = \frac{X}{560\text{g}}$ $X = 123.2$

120g NaOH

Pb 1(207.2) = 207.2
N 2(14.01) = 28.02
O 6(16.00) = 96.00 / 331.22 g/mol

Molarity

27. How many grams of $Pb(NO_3)_2$ are needed to make 500.0 mL of a 0.25 M solution?

$M = \frac{\text{mol } Pb(NO_3)_2}{\text{L solution}}$

Step 1: Convert mL into Liters $500.0\text{mL}\left(\frac{1\text{L}}{1000\text{mL}}\right) = .5000\text{L}$

Step 2: Determine # moles in the solution.

$.25\text{M} = \frac{x\text{ mol}}{.5000\text{L}}$ $\quad x = .125\text{ mol } Pb(NO_3)_2$

Step 3: Determine # grams (mol → g)

$.125\text{mol } Pb(NO_3)_2\left(\frac{331.22\text{g}}{1\text{mol}}\right) = 41.4025$ **41 g**

* See last page for alternative set up.

28. What is the percent by volume of a solution that contains 45.0 mL of acetone dissolved in 75.0 mL of cyclohexane?

solute — solvent.

$\% = \frac{\text{volume solute}}{\text{volume solution}} \times 100$

① Determine total volume of solution
75.0 + 45.0 = 120.0 mL

② Determine %

$\% = \frac{45.0\text{ mL acetone}}{120.0\text{ mL solution}} \times 100 =$ **37.5%**

29. What is the concentration of a solution in parts per million if the solution is 1.15% solute by mass?

percent = parts per 100.

$ppm = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$

$\frac{1.15}{100} = \frac{x}{10^6}$ $\quad x = 11500\text{ ppm}$

STOP FOR PART I OF SOLUTIONS TEST

Assessment II

30. Calculate the new boiling point of a solution in which 234.5 g Na_3PO_4 are dissolved in 600. g water?

$\rightarrow 3Na^+ + PO_4^{3-}$ $\quad i = 4$

① Determine molality of solution

Na 3(22.99) = 68.97
P 1(30.97) = 30.97
O 4(16.00) = 64.00
147.94 g/mol

$234.5\text{g } Na_3PO_4\left(\frac{1\text{mol}}{147.94\text{g}}\right) = 1.5851\text{ mol } Na_3PO_4$

$600.\text{g}\left(\frac{1\text{kg}}{1000\text{g}}\right) = .600\text{kg}$

② Solve $\quad \Delta T_{bp} = m(K_{bp})(i)$

$\Delta T_{bp} = \left(\frac{1.5851\text{mol}}{.600\text{kg}}\right)(.512\,^\circ\text{C/m})(4) = 5.41\,^\circ\text{C}$

③ new bp = $100^\circ\text{C} + 5.41 =$ **105.41°C**

C 2(12.01) = 24.01
H 6(1.01) = 6.06
O 1(16.00) = 16.00
46.07 g/mol

Assessment II

31. Calculate the new freezing point if 78.0 g C_2H_5OH, a nonelectrolyte is dissolved in 500.0 g of benzene. (For Benzene: k_{fp} = 5.12°C/m and freezing point = 5.533°C) $i = 1$

$\Delta T_{fp} = m \times K_{fp} \times i$

$\Delta T_{fp} = (3.38615\ m)(5.12°C/m)(1)$

$\Delta T_{fp} = 17.337°C$

new fp = 5.533 − 17.337 = **−11.804°C**

WORK FOR molality

$78.0\ g \left(\frac{1\ mol}{46.07\ g}\right) = 1.693076\ mol$

$500.0\ g \left(\frac{1\ Kg}{1000\ g}\right) = .5000\ Kg$

$\frac{1.693076\ mol}{.5000\ Kg} = 3.38615$

Assessment II

32. What is the vapor pressure of water at 80°C if 690. g of sucrose ($C_{12}H_{22}O_{11}$) is dissolved in 126.0 g of water?

$VP_{solution} = VP_{solvent\ @\ 80°C}$ (mole fraction solvent)

$C_{12}H_{22}O_{11}$
342.34 g/mol

$690.\ g\ C_{12}H_{22}O_{11} \left(\frac{1\ mol}{342.34}\right) = 2.0155\ mol\ sucrose$

$126.0\ g\ H_2O \left(\frac{1\ mol}{18.02\ g}\right) = 6.99223\ mol\ H_2O$

$VP_{solution} = 47\ kPa \left(\frac{6.99223}{9.00773}\right)$

$VP_{solution} = 36.5\ kPa$

Assessment II

33. The solubility product constant for $Al(OH)_3$ is 1.26×10^{-33}. What is the $[OH^-]$ in the solution when it reaches equilibrium?

$Al(OH)_3 \rightarrow Al^{3+} + 3\ OH^-$

$[Al^{3+}] = x$
$[OH^-] = 3x$
} ions are in 1:3 Ratio

$K_{sp} = [Al^{3+}][OH^-]^3$

$1.26 \times 10^{-33} = [x][3x]^3$

$\frac{1.26 \times 10^{-33}}{27} = \frac{27x^4}{27}$

$x^4 = 4.666 \times 10^{-35}$

$x = 2.613676 \times 10^{-9}\ M$

$2.61 \times 10^{-9}\ M$

#27 using dimensional analysis.

$$500.0\ \text{mL}\left(\frac{1\ \text{L solution}}{1000\ \text{mL}}\right)\left(\frac{.25\ \text{mol}}{1\ \text{L}}\right)\left(\frac{331.22\text{g}}{1\ \text{mol}}\right) = 41.4025\text{g}$$

41g $Pb(NO_3)_2$